

# *Operational Data Analytics in support of Facility Management*

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SC18 Operational Data Analytics (BOF)

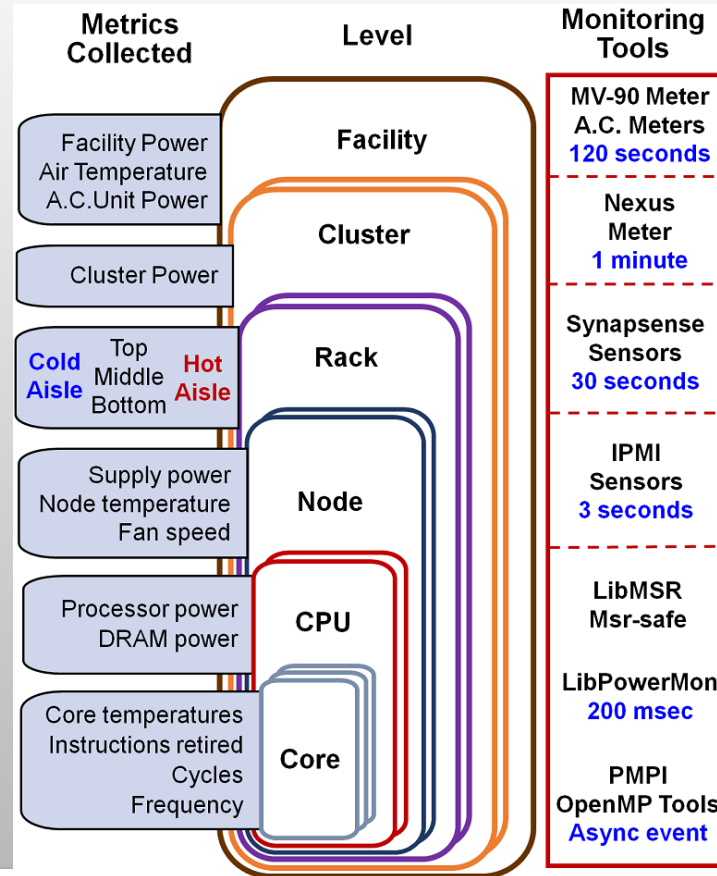


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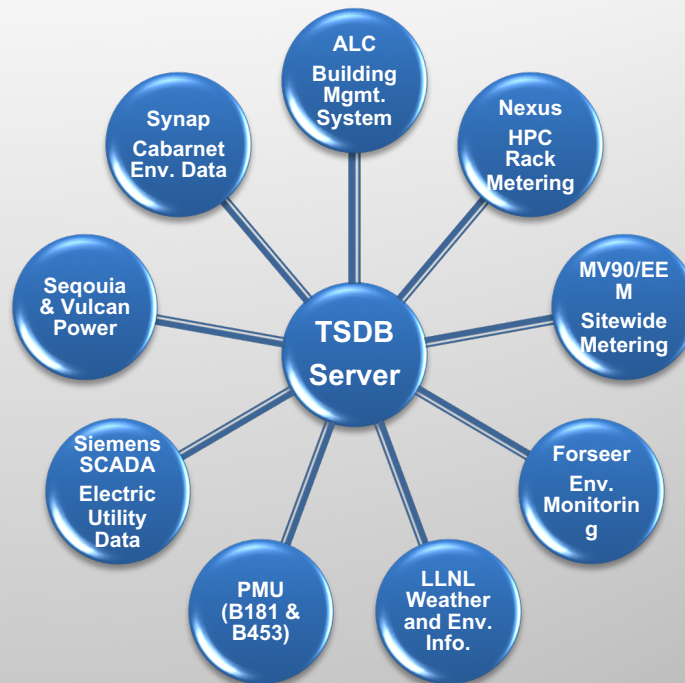


# Relate component, system, and facility level data to define optimization strategies

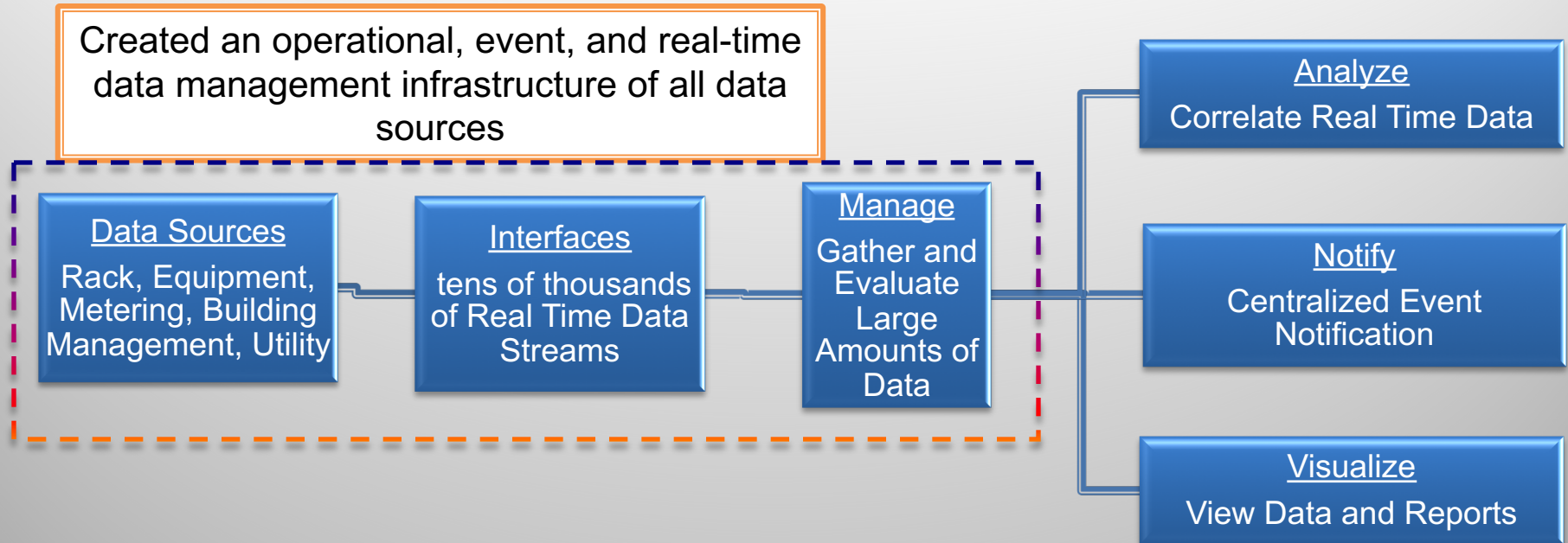


# You cannot optimize what you cannot measure

- Collect data
  - Diverse interfaces and different data rates ( $\mu\text{sec}$ -15m)
  - All sources are equally important
- 70k tags
  - 20k HPC
  - 50k NIF



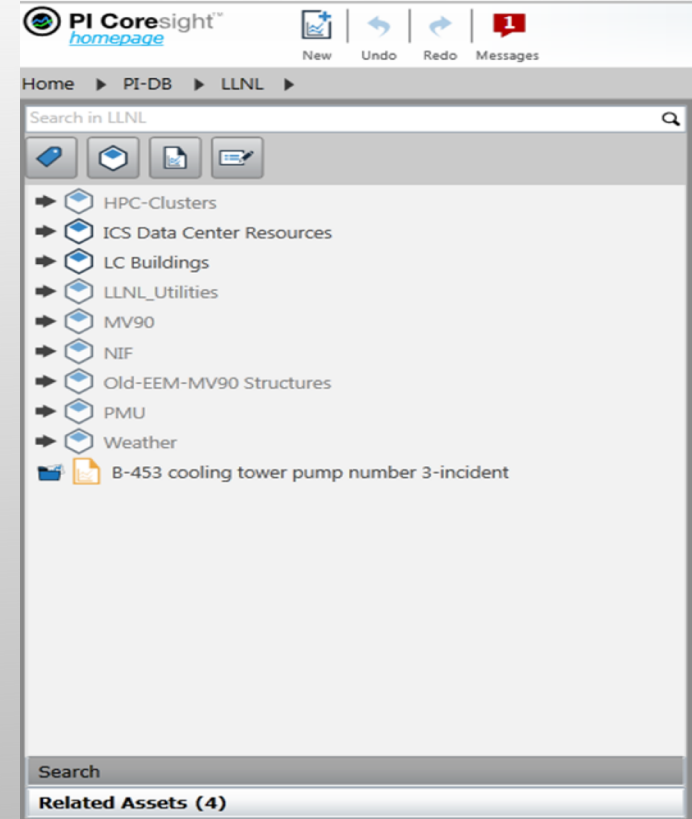
# Data acquisition and management is necessary but time consuming





# Efficient and user friendly data discovery interface

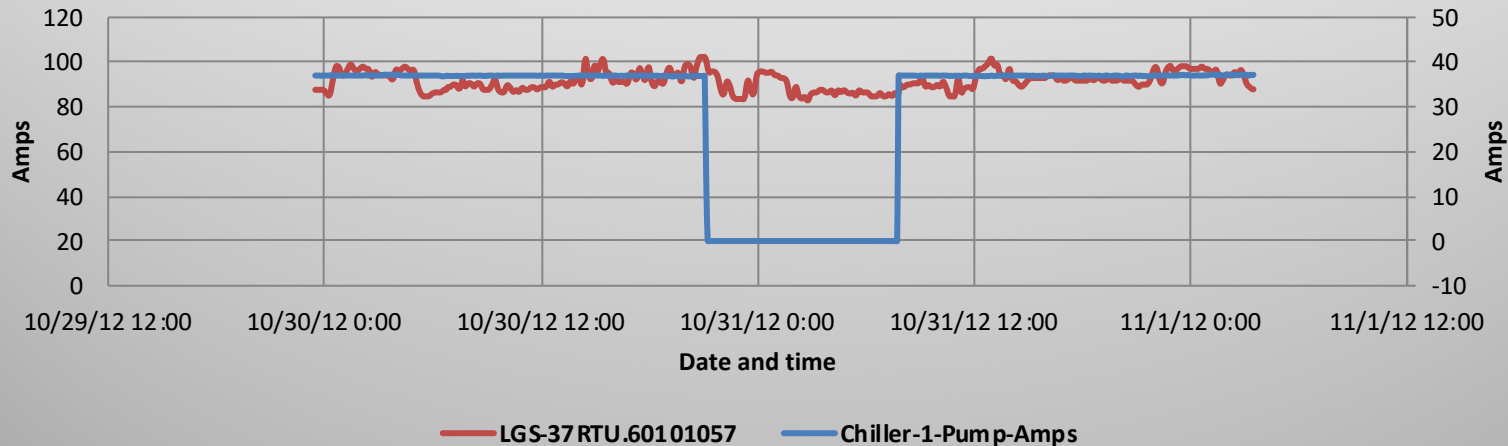
- We use a commercial database system from OSIsoft called PI
  - Hierarchical data model reflects the physical structure of the monitored systems
  - Multiple paths to the same data point
  - Related assets



# Chiller shutdown events

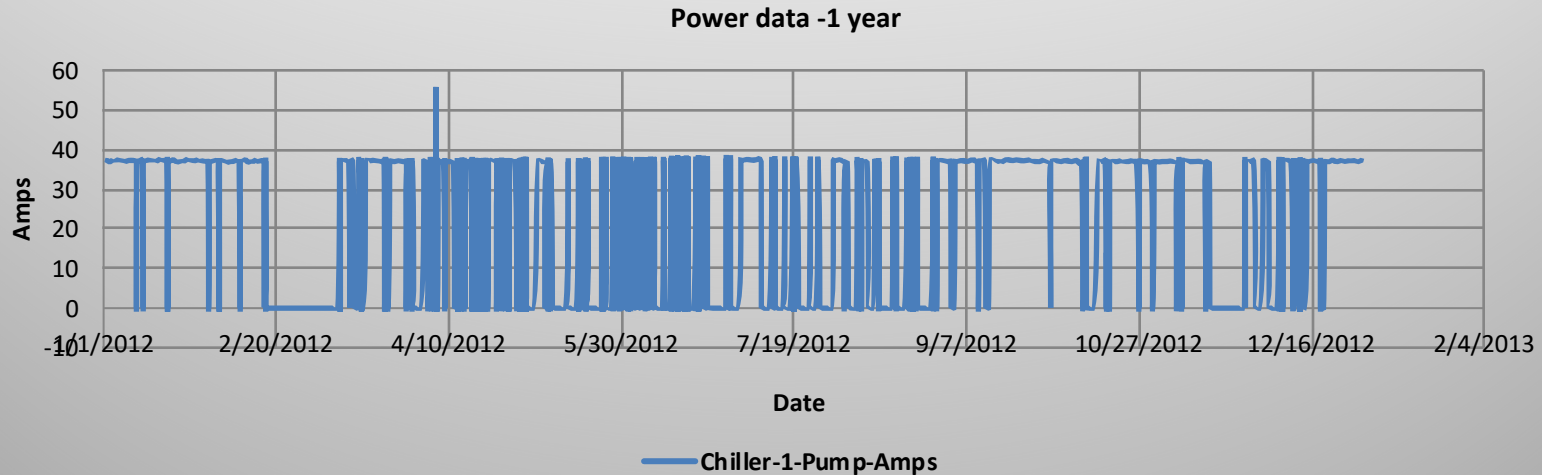
- Date and Time: 10/30/2012 9:08:18 PM
- Buildings: 453 chiller #1
- T1883 fed by LGS-37, 3705.

Power data at the time of the event

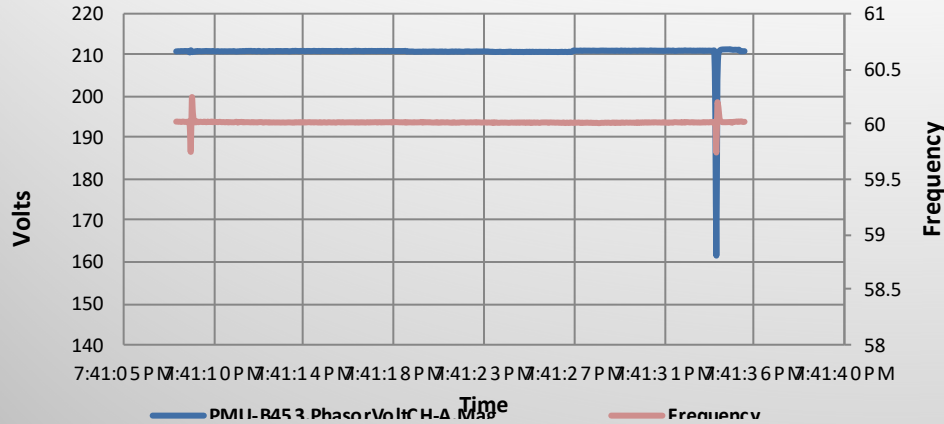


# Data over a year explains the chiller behavior

- The pump shuts down regularly and more frequently during the Summer
- No correlation with the electric signal
- Chiller is used for “staging”
  - Solution: redesign the system and replace with a larger chiller



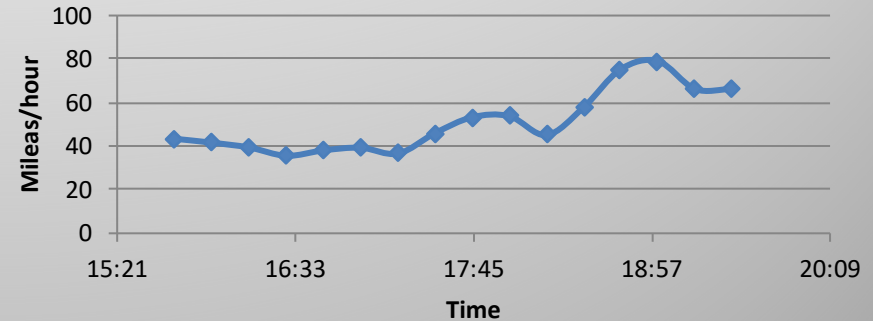
# Correlating different data streams



## ■ Voltage dip:

- 7:41 pm on 10/27/2013
- 10:51 pm on 02/08/2015

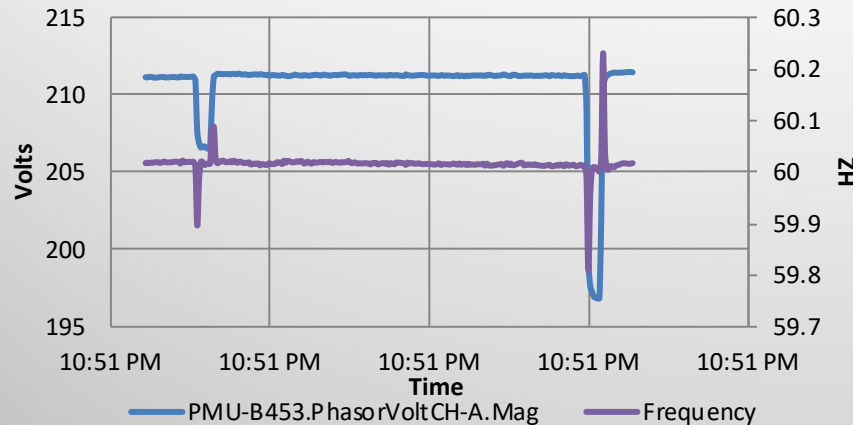
## Wind-Gust



- Wind with gusts over 67 m/h
  - SW and SSW direction
- Winds gusting below 67 m/h
  - Other directions

# Correlating different data streams

- 2/28/2015 event
- Very similar behavior

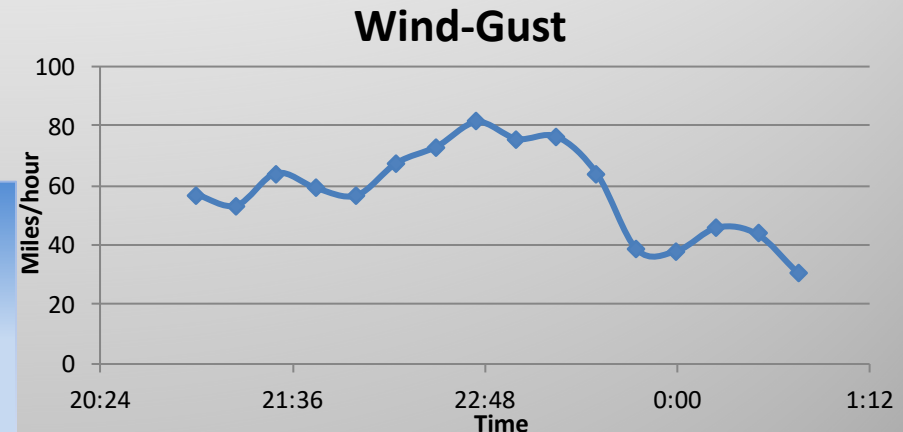


Two important steps:

1. Find similar events
2. Find what caused these events

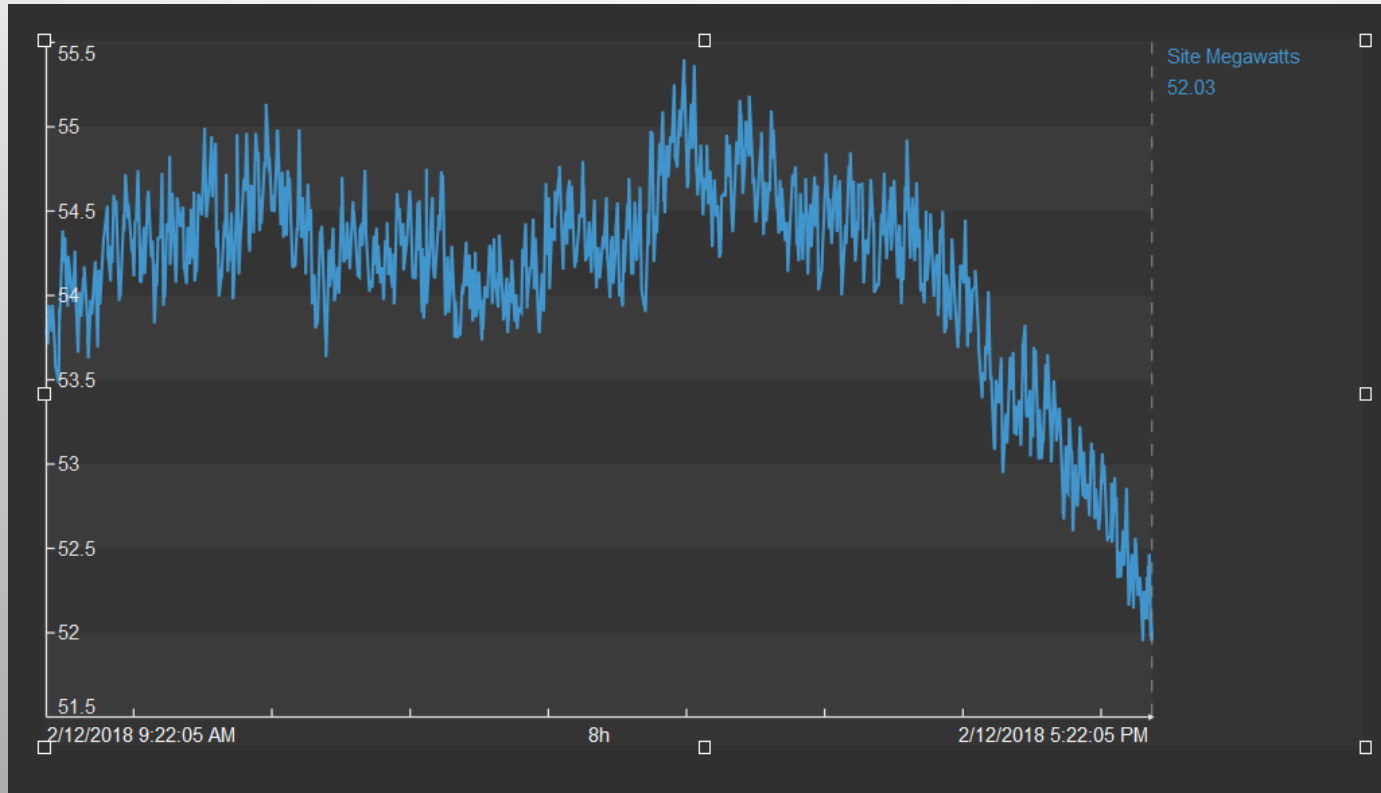
Can we automate the two steps?

1. Search
2. Cause and effect, correlation

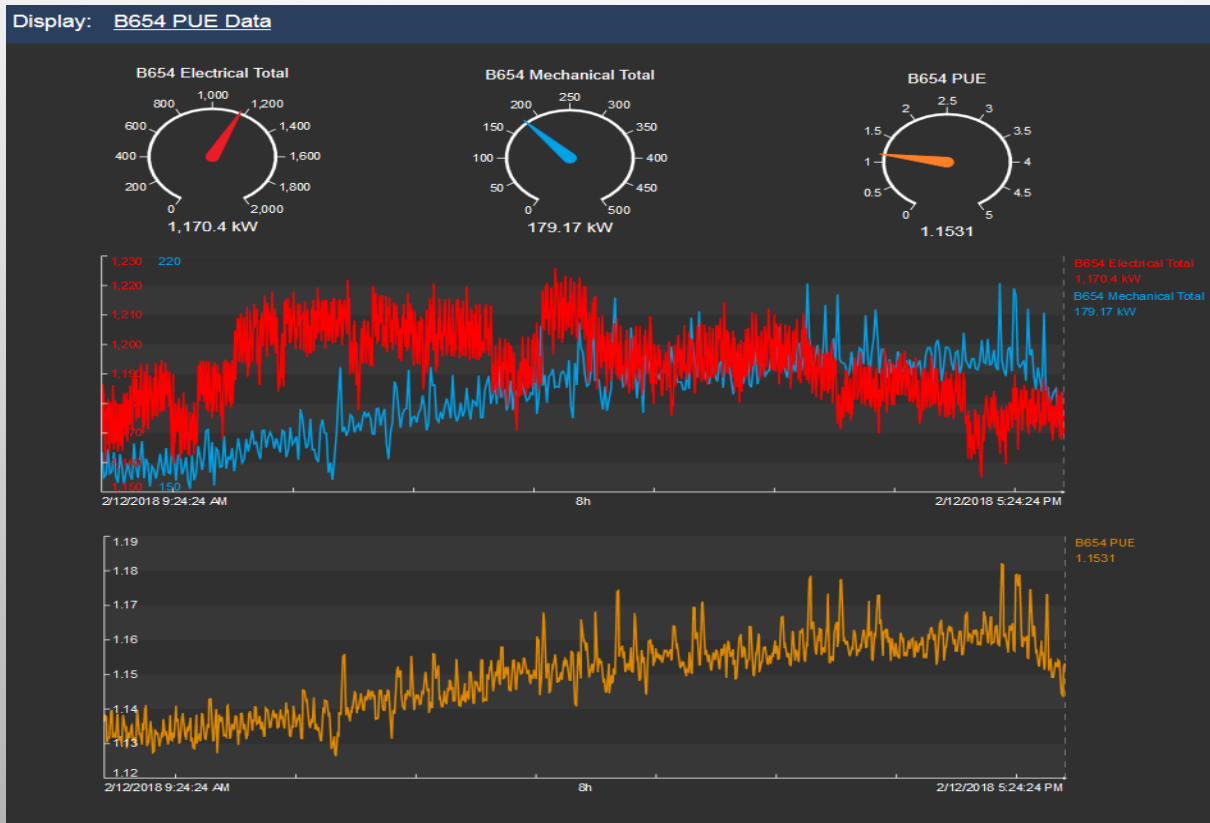




# Site wide load variability



# Real time PUE



# Monitoring our resources

## PMU Monitoring

Point Source	Pinode-01	Pinode-02
B181-PMU	Primary 1/26/2018 1:45:56 PM	Backup 1/26/2018 1:57:01 PM
B453-PMU	Primary 1/26/2018 1:45:54 PM	Backup 1/26/2018 1:55:59 PM
B453-PMU-LU2681B	Primary 3/1/2017 2:27:13 PM	Backup 3/5/2017 7:27:49 AM

## Nexus/SynapCab Monitoring

Point Source	Pinode-03	Pinode-04
Nexus	Primary 2/6/2018 7:17:20 AM	Backup No DataSource 2/6/2018 7:17:20 AM
B451-Synap-Cabernet	Primary 1/26/2018 9:06:52 AM	Backup 1/26/2018 2:01:41 PM
SCHNEIDERPM8000	Primary 1/26/2018 9:06:51 AM	Backup 1/26/2018 2:01:47 PM
Nexus-Utility-B654	Backup 2/7/2018 11:11:33 PM	Primary 1/29/2018 7:07:54 PM

## Foreseer Monitoring

Point Source	Pinode-05	Pinode-06
Foreseer	Primary 1/26/2018 9:06:13 AM	Backup 1/26/2018 9:06:17 AM

## Weather Monitoring

Point Source	Pinode-17
HTML	54 deg F 2/12/2018 5:15:00 PM

## Sequoia/Vulcan Monitoring

Point Source	Pinode-07	Pinode-08
Sequoia-1913A	Primary 2/12/2018 5:26:04 PM	Backup 2/12/2018 5:26:04 PM
Sequoia-1911A	Primary 2/12/2018 5:26:08 PM	Backup 2/12/2018 5:26:08 PM
Sequoia-1912A	Primary 2/12/2018 5:26:04 PM	Backup 2/12/2018 5:26:04 PM
Sequoia-1914A	Primary 2/12/2018 5:26:07 PM	Backup 2/12/2018 5:26:07 PM
Sequoia-1915A	Primary 2/12/2018 5:26:08 PM	Backup 2/12/2018 5:26:08 PM
Sequoia-1918A	Primary 2/12/2018 5:26:08 PM	Backup 2/12/2018 5:26:08 PM
Vulcan-1920A	Primary 2/12/2018 5:26:08 PM	Backup 2/12/2018 5:26:08 PM
Vulcan-1916A	Primary 2/12/2018 5:26:00 PM	Backup 2/12/2018 5:26:00 PM

## ALC Monitoring

Point Source	Pinode-09	Pinode-10
B453DDC-Office&East Mech	Primary 1/26/2018 9:06:18 AM	Backup 1/26/2018 9:06:25 AM
B453DDC-West Mech	Primary 1/26/2018 9:06:15 AM	Backup 1/26/2018 9:06:33 AM
B453DDC-Chiller&Hot Water	Primary 1/26/2018 9:06:19 AM	Backup 1/26/2018 9:06:30 AM
B453DDC-Cooling Tower&Condenser	Primary 1/26/2018 9:06:21 AM	Backup 1/26/2018 9:06:35 AM
SEQUOIA COOLING	Primary 1/26/2018 9:06:14 AM	Backup 1/26/2018 9:06:32 AM
B451DDC	Primary 1/26/2018 9:06:22 AM	Backup 1/26/2018 9:06:36 AM
VULCAN COOLING	Primary 1/26/2018 9:06:16 AM	Backup 1/26/2018 9:06:34 AM